

LIVESTOCK DEPREDATION BY WOLVES IN THE GREAT INDIAN BUSTARD SANCTUARY, NANNAJ (MAHARASHTRA), INDIA¹

SATISH KUMAR³ AND ASAD R. RAHMANI²

(With three text-figures)

Key words: *Antelope cervicapra*, blackbuck, *Canis lupus pallipes*, Indian wolf, depredation, pack size, livestock

Food habits of the Indian wolf (*Canis lupus pallipes*) were studied in the Great Indian Bustard Sanctuary, Nannaj, India, between 1991-1994. Estimation of wolf depredation on livestock is essential to implement compensation, management, and conservation plans for the wolf. Blackbuck (*Antelope cervicapra*) was the primary prey of wolves in the Sanctuary; goats and sheep were the major livestock taken by wolves. Data on livestock killed, age of the kill, distance of the kill from the Sanctuary, and the terrain where the kill was made were collected. More goats than sheep were killed, and livestock depredations were higher during the pup-rearing period of wolves, when pups were dependent on parents and/or helpers for food. Multiple attacks were made by wolves on livestock herds to divert the attention of guard dogs. Sixty-three percent of the kills were 1-4 m from a bush or some other vegetative cover. The maximum number of kills (52%) made during daytime were found up to 0.2 km from the Sanctuary plots. The owners retrieved 16% of the total livestock kills, by chasing the wolves or with the help of guard dogs. Mauled animals rarely survived. All the kills occurred in the grazing lands outside the Sanctuary, but kills were carried into the core areas of the Sanctuary. There was a monthly variation in the abundance of goats and sheep in the study area.

INTRODUCTION

The Indian wolf (*Canis lupus pallipes*), one of the smallest wolves of the world, represents the southernmost range limit of wolf distribution in the world (12° 57' N and 76° 50' E). The Indian wolf lives in smaller packs, usually 4-7 individuals. It is uncommon, and found in pockets of western, central and peninsular India in open grassland, scrubland, and rocky hills. The Indian wolf is protected by law and classified as endangered under the Indian Wildlife (Protection) Act, 1972. Unlike its temperate cousin, it litters in winter (Kumar 1998).

Compared to other races of wolves, the Indian wolf is unique in the environment in which it lives. Its conspecifics in other regions

are attracted to garbage dumps (Mendelssohn 1983a, b) around human settlements and are reported to scavenge goat and sheep carcasses in Saudi Arabia (Iyed A. Nader 1992 *pers. comm.*). This habit is not recorded in the Indian wolf.

The wolf and its principle prey, blackbuck (*Antelope cervicapra*), have responded positively to conservation measures in the Great Indian Bustard (GIB) Sanctuary (Kumar and Rahmani 1997). Wolves exist discontinuously all over the GIB Sanctuary in small packs because of the high human population residing in and around the Sanctuary and consequent disturbance (Kumar and Rahmani 1997). The Sanctuary covers numerous villages, towns, crop fields, grazing land and some pockets of forest land. The major natural prey of the Indian wolf in the GIB Sanctuary is the blackbuck. The blacknaped hare (*Lepus nigricollis*) and rodents are also taken as food. However, the wolf frequently preys on livestock, which brings it into direct conflict with humans. Livestock that fall prey to wolves are

¹Accepted March, 1999

²Bombay Natural History Society, Hornbill House, S.B. Singh Road, Mumbai 400 023, Maharashtra, India.

³Present address: Department of Wildlife Sciences, Aligarh Muslim University, Aligarh 202 002, Uttar Pradesh, India.

goats, sheep, calves of cows and buffaloes, pigs, and poultry fowl.

Wolf predation on livestock remains a highly complex and hotly debated issue in India, as depredations cannot be confirmed. Irrelevant claims by shepherds, farmers, and ranchers, differences of opinion over depredation, and exaggeration of the facts only worsens the issue. While conducting this study on the ecology of the Indian wolf in the Great Indian Bustard Sanctuary, Nannaj, we attempted to assess the magnitude of the wolf-man conflict resulting from livestock depredation, estimation of which is essential to implement compensatory payment, planned management, and long-term conservation of the wolf. Our studies on livestock depredation in this part of India were an attempt to answer a few questions on the hunting strategy

of wolves, magnitude of wolf-human conflict, and the seasonality of depredation.

STUDY AREA

Nannaj is a small village 20 km north of Solapur between 17° 41' N and 75° 56' E at 486 m above msl (Fig. 1). It lies in the drought prone area of the Deccan Plateau. Due to the rain shadow created by the Western Ghats, the drought prone area of Solapur and its adjacent areas in the Deccan Plateau receive an average rainfall of 750 mm, distributed over 3 to 4 months. The rainfall is erratic and drought is a common phenomenon. The climate of Solapur is semi-arid, with 3 seasons: summer (February to mid-June), monsoon (mid-June to mid-October), and winter (mid-October to January).

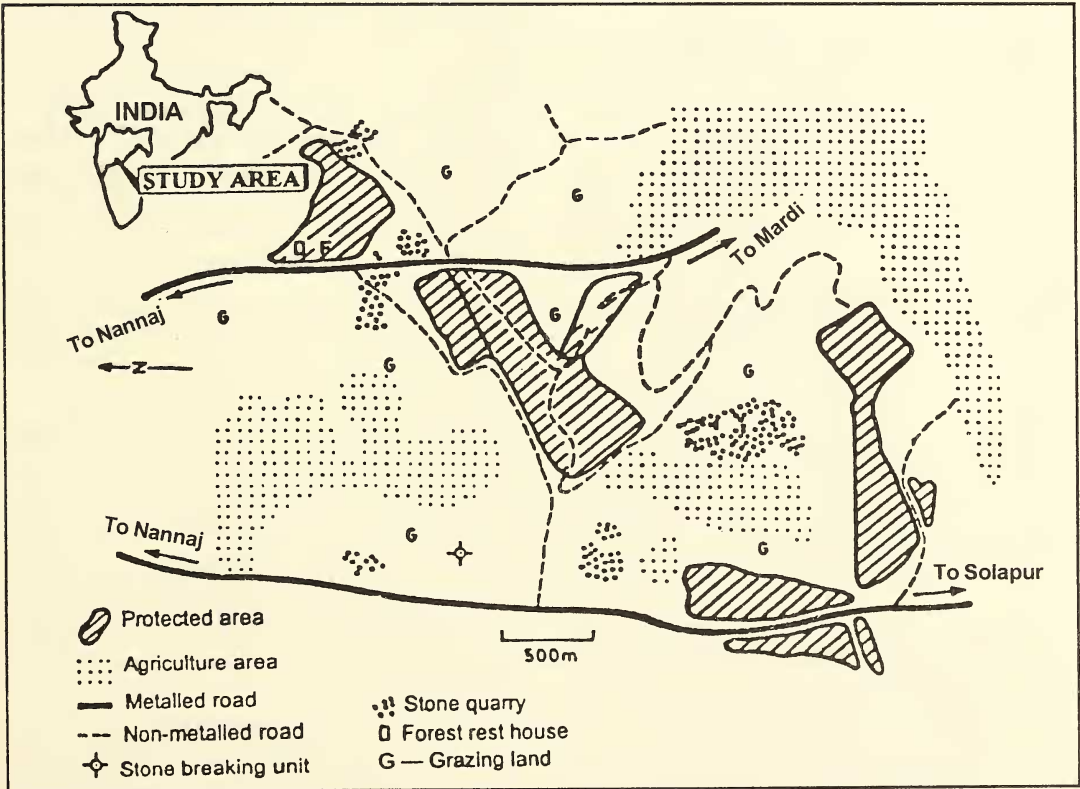


Fig. 1: The Great Indian Bustard Sanctuary, Nannaj, Maharashtra

The monsoon season starts in mid-June or early July with dry spells during late July and early August. There is adequate rainfall in late August and September, which ceases by mid-October. The average temperature varies from 10 °C in December to 45 °C in May. The substratum is comprised of half-decomposed basalt rock formations. The terrain is gently undulating with mild slopes and flat topped hillocks with intermittent shallow valleys, which form the major drainage channels. Grasslands are distributed in disjunct, fragmented patches, forming a mosaic of grazing and agricultural lands and human settlements. Most of the grasslands are present on cultivable slopes and tops of the hillocks. These grasslands are government owned as well as private, and constitute the 'commons' meant for grazing.

In 1975, the Drought Prone Areas Programme (DPAP) financed by the World Bank was initiated in the Solapur district. The DPAP is an area development programme, aimed at integrating efforts in the agricultural and allied sectors to mitigate the adverse effects of drought, by developing land, water, vegetation, livestock and the restoration of ecological balance. The establishment of pastures and plantation plots by the Forest Department under this scheme witnessed resurgence of wildlife. In the early 1980s, some plantation plots were established under the District Rural Development Agency (DRDA). The area around Nannaj can be broadly divided into (1) Protected DPAP/DRDA plots (plantations and grasslands) (2) Unprotected grazing land, and (3) Crop fields.

The protected plots are under the control of the State Forest Department. All DPAP plots are surrounded by grazing or agricultural land. The DPAP plots can be sub-divided into plantation and grassland. Many new plots are coming up in the area under Social Forestry Plantation Schemes.

METHODOLOGY

We conducted ecological and behavioural studies on the Indian wolf for three years in an area of 30 sq. km in the GIB Sanctuary, Solapur, between June 1991 and September 1994. One pack (named Nannaj Pack) was observed for detailed behavioural studies. Two other packs, Gangewadi Pack and Mohol Pack were identified around the Sanctuary. The Gangewadi Pack was present 20 km northeast from the centre of the Nannaj Pack territory, whereas Mohol Pack was 25 km west of the Nannaj Pack territory. Data on livestock depredations were collected by ground surveys and also from information given by shepherds and farmers around the Sanctuary. They were encouraged to report any incidence of wolf depredation for further investigation. To estimate losses due to depredations, interviews were conducted during the studies on wolves. Sometimes kills were located opportunistically during ground-surveys for wolf tracks.

First-hand investigation of the livestock depredation claims helped to minimise major biases due to false claims. A complaint was considered authentic if our investigation revealed some evidence such as a wounded animal, remains of the victim, blood stains on grass, wolf tracks, chase sequences on the ground, and signs of struggle. Physical examination of the kill site was done immediately on receiving a report.

The Indian wolf is the only large predator in the study area, hence depredation by other large predators was ruled out. Farmers and shepherd communities informed us about wolf behaviour, particularly its depredation activities at night. The first author (SK) occasionally stayed with shepherds at night to observe wolf activity around villages and confirm the information supplied by them.

On receiving a complaint of depredation, information was collected on the sex and age of the kill, whether the kill was rescued, presence of sheep dogs, and habitat type. The terrain,

vegetation height at the kill site, and nearest vegetative cover from the kill was also recorded. Total count of the livestock was done on a weekly basis around the Sanctuary area to assess its local population. Some elevated spots in the Sanctuary with higher visibility were selected to make counts. The counts were done between 1400 and 1600 hrs, when a maximum number was expected around the Sanctuary. Livestock refers to goats and sheep.

The three wolf denning periods are: (1) December 1991-November 1992 (litter born or raised), (2) December 1992-November 1993 (no litter born), (3) December 1993-November 1994 (litter born).

For some analyses, the denning periods (1) and (3) were further sub-divided into two periods: (a) denning period (pups are dependent on parents and other members of the pack for food; December to May); (b) post-denning period (juveniles start hunting with the parents or independently. This was observed between June and October, after which they start separating and dispersing. Sometimes the pack members were seen in very loose associations).

This was done to test any difference in depredations when (i) the pups were restricted to dens or rendezvous sites, (ii) the juveniles started hunting, and (iii) no breeding took place.

Nonparametric statistical analysis was performed on the data. Differences in predation on goats and sheep were tested by chi-square test. Difference in depredations during the denning period (1) and (2), and between (3) and (2) were tested by Mann-Whitney U test, whereas Kruskal-Wallis one-way analysis of variance was performed when the kills were grouped into three categories. Data collection was completed in August 1994, hence depredations for the year 1993-94 were only for eight months. The pack size of wolves during the study period was not constant; livestock kills were therefore averaged for various comparisons.

RESULTS

The Nannaj wolf pack bred during 1991 and 1993. Pack size varied from 2-7 individuals (excluding pups). No active den was found in 1992; no breeding was observed, probably due to severe drought. During the study period, 101 animals (77 goats and 24 sheep) were attacked by wolves. Of the 16 mauled animals (13 goats and 3 sheep), only 3 goats and one sheep survived. The mauled animals did not die due to infection of wound. All these animals had bites on the neck, muzzle, and head. Of the total kills, the owners retrieved 16% by chasing the wolves or with the help of sheep dogs. Wolves killed twenty goats and sheep at night and the remaining during the day. The night kills (n = 20) were located at 3 km or more from the protected core areas of the Sanctuary.

Of 12 kills during 1991-1992 (monsoon 1991 and winter 1991-1992), maximum depredation occurred in winter (n = 11). This was probably due to the absence of pups with the pack during monsoon 1991 and the presence of five pups during the winter of 1991-1992. During 1992-1993 (summer and monsoon 1992 and winter 1993-1994), maximum kills were found in monsoon (50%) and summer (43%), and the remaining in winter (7%) of 1992-1993 (Table 1), which was probably due to the presence of pups during monsoon and summer, and small pack size during winter when the pack was dissociated and dispersed. During rains, shepherds shelter under trees, while their livestock graze in a wide area, giving wolves ample opportunity to attack the temporarily unguarded herds (Kumar 1998).

No livestock kill was reported in the summer and monsoon of 1993. This was because the shepherds had migrated to other areas where rainfall was higher during a drought year. Some shepherds stayed back with a few herds of livestock that were spread over a wide range. The wolves likewise travelled over a larger area in

LIVESTOCK DEPREDATION BY WOLVES IN THE GREAT INDIAN BUSTARD SANCTUARY

TABLE I
DOMESTIC UNGULATES KILLED BY WOLVES
DURING DIFFERENT SEASONS FROM 1991-1994
IN THE GREAT INDIAN BUSTARD SANCTUARY

Seasons	Livestock Depredation		Total
	Goats	Sheep	
Monsoon 1991 (mid-June - mid-October)	0	1	1
Winter 1991-92 (mid-October - January)	10	1	11
Summer 1992 (February - mid-June)	13	6	19
Monsoon 1992 (mid-June - mid-October)	14	8	22
Winter 1992-93 (mid-October - January)	2	1	3
Summer 1993 (February - mid-June)	0	0	0
Monsoon 1993 (mid-June - mid-October)	0	0	0
Winter 1993-94 (mid-October - January)	9	1	10
Summer 1994 (February - mid-June)	24	4	28

search of food. Hence, it is likely that some kills were undetected. The lack of pups (no breeding was observed during 1992-93), and the presence of only two wolves in the territory of the Nannaj Pack in 1993, could also be other reasons for low wolf depredation. Depredation was conspicuous again during the winter of 1993-1994 and summer of 1994. Of the 38 kills, the wolves made 28 (74%) in summer 1994 (Table 1) and the remaining in winter of 1993-94. Maximum depredations occurred in summer 1992 and 1994 and also in monsoon 1992, which was apparently due to the higher demand of growing pups for food. Wolves relied on easy prey at such times, and expended less energy searching for blackbuck. Occasionally, two or more goats were killed by wolves (n = 6) during the same attack. We actually saw wolves hunting and killing goats and sheep six times.

The livestock population of five villages in the GIB Sanctuary namely, Nannaj, Mardi,

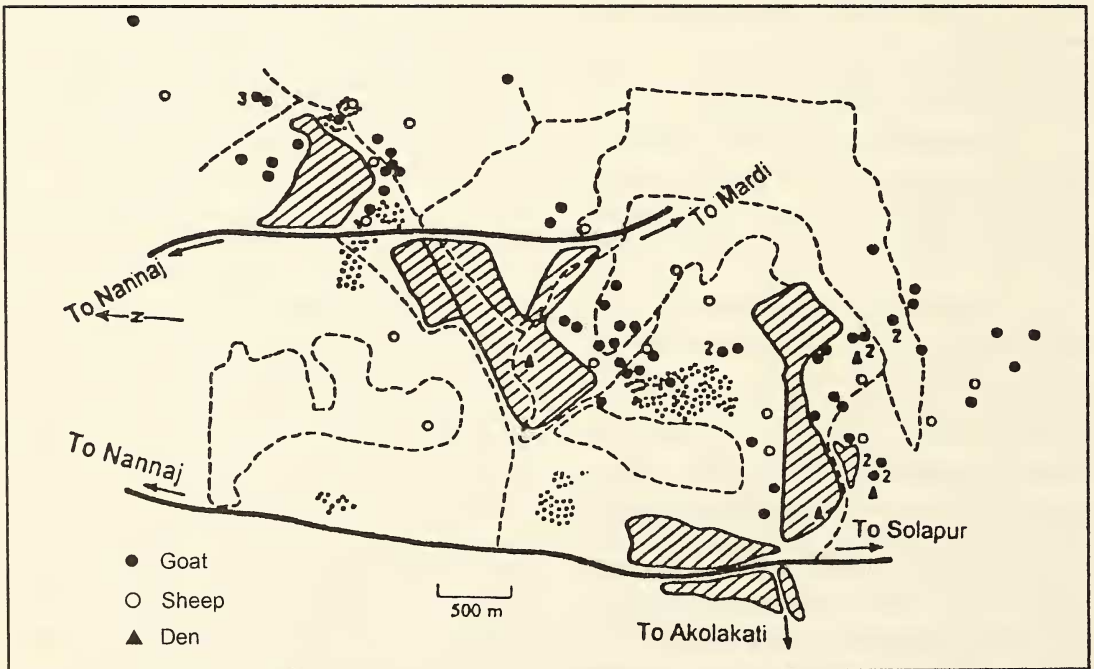


Fig. 2: Distribution of livestock kills by wolves between July 1991 and August 1994.
(Numbers represent the animals attacked simultaneously)

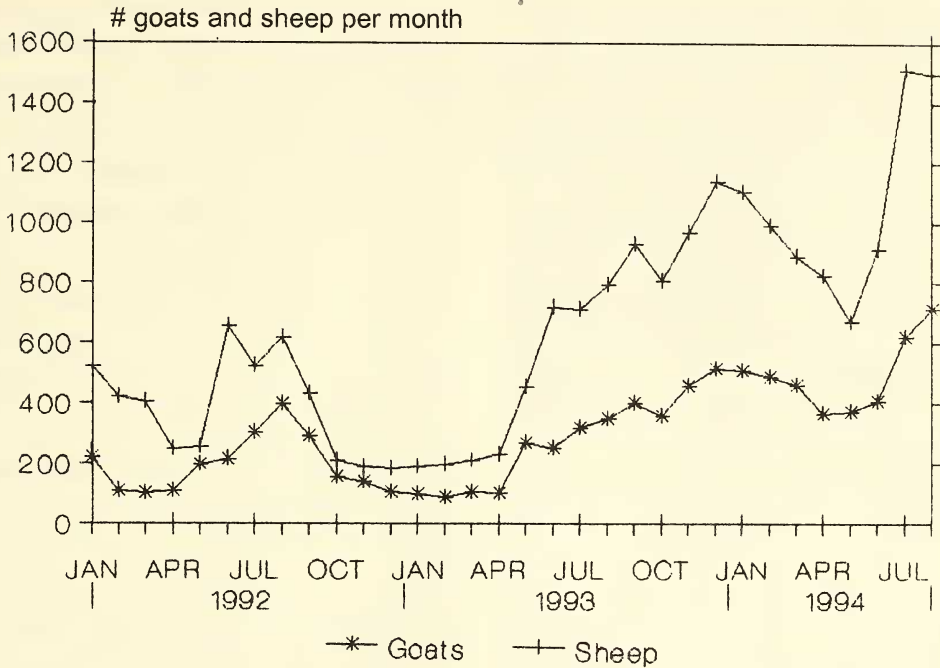


Fig. 3: Monthly variation of goats and sheep in the Sanctuary (numbers are average of weekly counts)

Akolakati, Vadala, and Narotewadi was much higher than the actual numbers grazing in the study area because some grazed outside the study area. Our maximum counts were 743 sheep and 410 goats in 1992, 1,190 sheep and 531 goats in 1993, and 1,706 sheep and 813 goats in 1994 (Fig. 3).

The majority of the kills made during daytime (52%) were found up to 0.2 km from the protected pasture and wood lots of the Sanctuary, probably because the wolves carry the kills into the core areas of the Sanctuary which are undisturbed. Four percent of kills were found at 1 km or more from the Sanctuary. The remaining kills (44%) were found between 0.2-1.2 km from the Sanctuary plots.

The linear distance of diurnal wolf kills of livestock from the protected plots of the Sanctuary (Fig. 2) varied from 0.01 to 1.25 km ($\bar{x} = 0.3$ km, $n = 81$). In contrast, the distance of the kills made at night varied from 3.0 to 3.5 km

($\bar{x} = 3.2$ km, $n = 20$). Sixty-three percent of the kills were 1-4 m from a bush or some other vegetative cover. Thirty-six percent were 5-12 m from the nearest vegetation, and only 1% kills were 13-15 m from vegetation, implying that most of the victims may have been ambushed by wolves.

Depredations claimed by farmers and shepherds should be interpreted cautiously because of false information. During this study, seven false attacks were reported by locals. Most stated that the wolves entered their livestock corrals on the outskirts of the villages during monsoon, particularly when it was raining. The corrals generally have 1 m high walls which wolves can easily jump over. Slightest laxity on the part of shepherds guarding such livestock confinements gave opportunity to wolf to make a kill. This was confirmed four times by staying with the shepherds. Over a period of time, the wolf must have learned that attacking animals

in a corral during a rainy night was easy, as men and dogs both take shelter.

The wolves killed more goats and sheep during the breeding years 1991-92 ($U = 2,631$, $P < 0.001$, Mann-Whitney U Test) and 1993-94 ($U = 1,280$, $P < 0.01$, Mann-Whitney U Test) than during the non-breeding year (i.e., 1992-1993). Depredations were higher during the denning period 1991-1992 ($H = 48$, $P < 0.001$, Kruskal-Wallis Test) as well as 1993-1994 ($H = 14.3$, $P < 0.01$, Kruskal-Wallis Test) when pups were dependent on parents and/or helpers for food, followed by the period when juveniles also start hunting, and the least during non-breeding years.

There was differential predation on goats and sheep. Goats were more susceptible ($\chi^2 = 14.25$, $df = 1$, $P < 0.001$) to wolf depredation than sheep during the study period (1991-1994) despite higher availability of the latter (Fig. 3). The ratio of goats to sheep counts was 1:2.8. Similarly, there was a difference between the number of goats and sheep killed in 1992 ($\chi^2 = 8$, $df = 1$, $P < 0.01$) and 1994 ($\chi^2 = 9.13$, $df = 1$, $P < 0.005$). This may be due to one or more of the following factors: preference of wolves for goats, goats were ambushed by wolves when browsing shrubs and short bushes, and goats were more dispersed as compared to the compact herds of sheep. There was a monthly variation in the abundance of goats and sheep in our study area (Fig. 3).

DISCUSSION

Any damage by wildlife in a developing country like India is a major concern for politicians, agriculturists and wildlife conservationists. Lack of information can lead to controversial decisions on managing a specific wildlife damage problem (Berryman 1984). A comprehensive national policy involving adequate compensation payment to solve wildlife-human conflicts is also hampered due to inadequate information.

The wolf in Maharashtra and in India is not secure, as it lives in the interfaces between agricultural and grazing land. It is poisoned and killed indiscriminately, particularly due to wolf-man conflicts. During March-October 1996, there were reports of 63 children being killed and attacked by wolves in three districts of Uttar Pradesh namely Pratapgarh, Jaunpur and Sultanpur. This resulted in extreme public animosity toward wolves in the entire country. In February-March 1997, five children were killed and five seriously mauled in Rae Bareli, a district adjacent to Pratapgarh and Sultanpur, followed by the killing of another child in Rae Bareli during May-June 1998. Subsequently, three more children were reported to be devoured by wolves in Rae Bareli in July 1999. About 15 wolves were eliminated by police and forest guards deployed in the affected areas during the operation. Owing to such aberrant behaviour of the wolf, coupled with livestock depredations, it is difficult to have public support for wolf conservation in India.

Multiple attack on livestock by wolves appear to divert the attention of sheep dogs. By the time they come to defend one victim, other pack members attack another animal, confusing the dogs. The wolves thus succeed in killing livestock even when they are guarded by dogs.

The wolf population has witnessed some resurgence in the Nannaj area of Solapur after the establishment of the Great Indian Bustard Sanctuary in 1980. The wolves have become visible as harassment by people has been reduced after protection of the area.

The utilization of prey by predators in the nature reserves depends on many circumstances, which change in space and time (Filonov 1980). The Indian wolf has a litter during Dec.- Jan., and the pups leave the den in February or early March. Most of the livestock get killed from December to May. During this time, shepherds try to kill wolves or pups in the dens. The livelihood of the Dhargar tribes which keep goats

and sheep depends entirely on selling these domestic ungulates and their products. They live in the whole of the Sanctuary. Once an active wolf den is located, they fumigate and block the den to kill the pups and sometimes even adults.

The Indian government provides no compensation to farmers for wolf depredation of livestock. Most of the livestock owners-shepherds, Dhangars, and farmers are very poor (average annual income, <Rs. 9,000 [US \$ 300]) and loss of even a single goat or sheep is substantial. The farmer and grazier communities suffer on two accounts: their common grazing land is taken under different soil conservation and afforestation schemes, and they lose their livestock to wolves. One of the most important questions to be considered for wolf conservation is the payment of adequate compensation by the government (Sawarkar 1986). Currently in India, compensation payment is made only for the animals killed by tiger (*Panthera tigris tigris*) and lion (*Panthera leo persica*).

Based on our investigations of wolf-livestock conflicts during 1991-1994, the total monetary losses of livestock due to wolves in the GIB Sanctuary, Nannaj were about Rs. 97,380 (US \$ 3,246) and Rs. 69,570 (US \$ 2,319), if the animals retrieved by graziers are not considered. Livestock depredation is greater in the Sanctuary, because of relatively higher wolf density (4 wolves per 100 sq. km), whereas most of the areas are inhabited by very low wolf numbers (Kumar and Rahmani 1997). A program in the United States which compensates farmers for livestock destroyed by wolves pays an average of US \$ 32,170 per year (Paul 1995)

for the single state of Minnesota. The program provides compensation as high as \$ 400 per animal killed by wolves (Fritts *et al.* 1992).

India is a densely populated country having a thousand million people, yet the wolf is surviving in highly populated areas around settlements, villages and towns. The wolf habitat, unlike that of the tiger, is densely populated, so the problem of livestock depredation is more complex and will remain so in the wolf areas. There seems no easy solution to wolf-human conflict but to reduce the problem by fully or partially compensating the farmers for livestock losses. The compensation after preliminary investigation should be provided with least delay if the wolf is to be preserved in the Sanctuary and some other protected areas in India.

ACKNOWLEDGEMENTS

The research work was done under Grassland Ecology Project, a joint effort of the Bombay Natural History Society (BNHS) and the Aligarh Muslim University (AMU). We thank the US Fish and Wildlife Service, particularly Prof. Mark Behan and SFC Coordinator Mr. David Ferguson, for funding and the Ministry of Environment and Forests for sponsoring the project. We also thank Dr. J. S. Samant, then Director, BNHS and the Chairman, Centre for Wildlife and Ornithology, AMU for facilities. We thank Drs. Y.N. Rao, Ajith Kumar, Ranjit Manakadan and Sálím Javed for discussions and the Forest Department of Maharashtra for help. We also thank our field assistants, Mr. Rajesh Jadhav and Mr. Navnath Vaghe.

REFERENCES

- BERRYMAN, J.H. (1984): Wildlife damage control: a current perspective. *Proc. East. Wildl. Damage Control. Conf.* 1: 3-5.
- FILONOV, C. (1980): Predator-prey problems in nature reserves of the European part of the RSFSR. *J. Wildl. Manag.* 44(2): 389-396.
- FRITTS, S.H., W.J. PAUL, L.D. MECH & D.P. SCOTT (1992): Trends and management of wolf-livestock conflicts in Minnesota. *Resour. Publ.* 181. U.S. Fish and Wildlife Service, Washington, D.C. 27 pp.
- KUMAR, S. & A.R. RAHMANI (1997): Status of Indian grey wolf *Canis lupus pallipes* and its conservation in marginal areas of Solapur district, Maharashtra. *J. Bombay nat. Hist. Soc.* 94(3): 466-472.

LIVESTOCK DEPREDATION BY WOLVES IN THE GREAT INDIAN BUSTARD SANCTUARY

- KUMAR, S. (1998): Ecology and behaviour of the Indian grey wolf (*Canis lupus pallipes* Sykes, 1865) in the Deccan grasslands of Solapur, Maharashtra, India. Ph.D. thesis, Aligarh Muslim University, Aligarh, India. 215 pp.
- MENDELSSOHN, H. (1983a): Status of the wolf in the Middle East. *Acta Zool. Fennica* 174: 279-280.
- MENDELSSOHN, H. (1983b): Conservation of the wolf in Israel. *Acta Zool. Fennica* 174: 281-282.
- PAUL, W.J. (1995): Trends and management of wolf-livestock conflicts in Minnesota. Abstracts p # 8, International Symp. Wolves and Humans 2000 — A global perspective for managing conflict, March 9-12. Duluth, MN, U.S.A. 46 pp.
- SAWARKAR, V.B. (1986): Animal damage: predation on domestic livestock by large carnivores. *Indian Forester* 112: 858-865.

